

Boiler Performance Test Plan for Burners & Over Fire Air System

9/03/03 r0

IGS Unit 1 POST-Outage Testing

Testing Objectives- The primary objective of the proposed testing is to collect NOX and CO emissions data (along with all operational data) from the burner and overfire air system. The following Testing Series of Boiler-Burner/ OFA Tests are being requested following the modifications and tuning which have been made to IGS Unit 1 burners and overfire air system. The Unit 1 Major Outage (4 week) modifications consisted of installing an overfire air system above the burners and extending the superheater platen section.

The tuning consisted of 1) Burner Line (Coal) Balancing which consisted of installing dynamic coal restrictors on all 8 sets of 6 burner lines and conducting dirty air flow tests and balancing test series to reduce side to side coal imbalances, 2) Air Flow Balancing through the Burners. This consisted of balancing inner and outer air flows through the dual register burner. One of the objectives was to increase windbox duct pressure by throttling flows thru the inner four burner's outer registers. The economizer duct Flue Gas Test Grid was used to provide profiling capability to focus in on "bad actor" burners. Note, we have conducted all of the above testing and balancing in the past, but to achieve the next level of emissions reduction, we have to take balancing and tuning to the next level.

The **purpose** of the POST-outage testing is as follows: The **State of Utah Air Quality** has requested IPSC to demonstrate and document operating conditions after the Overfire Air System has been installed. POST-outage testing is being conducted based on concerns from the State that operating with the overfire air system may result in an exceptional increase in CO emission levels.

The Boiler Testing will be at POST-Outage Test Conditions (i.e.- new uprated Load of 950 MWgross), Coal Supply- must be consistent- NO Westridge and Dugout coal blends (best if SUFCO is straight), O2% & Overfire Air% varies to give us CO, NOx emissions (see Boiler Test Conditions and Operational Test Setup).

Test Personal: The testing is being conducted by IPSC Engineering who is leasing test quality gas analyzers from Power Generation Technologies (PGT).

Test Coordinators- Aaron Nissen and Garry Christensen
Gas Analyzers and Test Grid- Garry Christensen & Rob Jeffery
Tech Support, Coal & Fly Ash sample collection- Dave Spence & Bernell Warner
Fly Ash Sample Collection- - ISG Rod Hansen, Rick Fowles/ Kurt Aldredge
OFA System Controls and Dampers- Ken Neilson & Phil Hailes
Babcock Power interface- Dan Coates

Test Method- Testing will utilize the station "PI" data acquisition system to document test conditions and collect plant operating data. In addition, a test grid is setup at the boiler outlet (11th floor) using 14 test probes at four different depths for a total of 56 points. The gas sampling system is setup with both east and west side averaging systems consisting of bubblers, vacuum pumps, chillers and desiccant filters. The mixed, cooled, dry, filtered gas samples are then analyzed for O2, CO2, CO and Nox and data collected and stored via data acquisition system. This information is then dumped to a spreadsheet for statistical analysis and averaging. Thermocouples are also at each location to get averaged boiler gas outlet temperatures. Additionally, we have a test setup at the base of the Stack to collect a CO gas sample at the 355' level using the Environmental Group's RATA Test Trailer. This sample is also conditioned and analyzed and stored on a data acquisition system for analysis.

NOTE, we will utilize the O2 test grid measurement at the boiler outlet to refine test conditions (compared to control room O2 probes) . We are seeing a bias between station O2 and the O2 at the boiler outlet grid. The O2% at the boiler outlet, however, agrees with higher Air Flow shown in CCS, correlates with the higher ID Fan rpm and amps, plus correlates with higher NOx and low CO levels. As part of the testing, we will try to reconcile why we have such high station O2 levels.

In addition to east and west side averaged gas conditions, individual test points will also be taken during a separate test to develop backpass test grid profile. These profiles will include O2, CO and temperatures which will be used to troubleshoot and diagnosis burner dual register setup, secondary air flow side to side splits, plus overfire air flow balancing issues.

Boiler Testing- Time Frames Each test point needs at least 2 hours, allowing ½ to 1 hour between test points to lower O2, pull fly ash and sootblow for temperatures. ½ to 1 hour is needed to stabilize operating conditions. Each test needs a minimum of a hour of very steady state test conditions. Prior to each test period (daily), the gas analyzers need to be started, warmed up and calibrated. This process takes 1 to 1 ½ hours to complete. During this time, all tubing, bubblers, chillers, desiccant filters, and dust filters will be checked out.

OFA System Damper Positioning- 1/3 and 2/3 dampers plus OFA secondary air inlet dampers will need to be moved and position checked during the course of the testing. The 1/3 dampers have had actuators replaced with larger heavy duty drives. They have been recently installed and stroked, but several (NW & SW) have been hanging up. There is some concern about linkages breaking internally and unable to achieve good balanced OFA flows.

Fly Ash Samples will also be taken and correlated with the test results. We will need 2 Operators to help support fly ash sample collection. ISG will be collecting the fly ash samples at each of the different test points. All fly ash hopper rows need to be available (no maintenance work) and hoppers will need to be pulled down prior to the start of the first test (night shift pulling prior to 7:00 am each day) and then hoppers will be pulled between each test point (while samples are being taken). Depending on the test series, bottom ash samples will also be collected as part of the boiler performance testing evaluation.

Coal Samples will also be taken throughout each test period at the coal feeder inlet spouts (test taps installed special for testing). Note: there maybe a certain amount of coal spillage created while collecting these coal samples. We will ensure coal spillage will be cleaned up at the end of each day.

Flue Gas Sampling Test Grid Equipment (11th floor, rear of the boiler, west side)- We have rented precision gas analyzers to be used for burner and OFA tuning and testing, this equipment also includes data acquisition system and Lap Top computer. There is also calibration bottles (O2, NOX, & CO), packing crates & boxes, hoses and tubing, tools, tool cart, power supply, air hoses & lances, bubblers, chillers, desiccant filters, vacuum pumps, etc., etc. We are running a swamp cooler (with water flow) plus an air handling fan on the 11th floor NW corner to keep analyzers and test personnel from over-heating. Please help us keep an eye on this equipment. This test equipment is worth several \$100K, so please DO NOT WASH DOWN this area, unless we are notified. We can accommodate a washdown (as we have in the past), be need to put the system to bed (power down equipment, disconnect power supplies, box and crate analyzers, etc.) and cover everything else up with plastic tarps.

Maintenance Support Requirements-

Pulverizers- Pulverizer U1F is down for major overhaul. If there are problems with any other pulverizer, we will need priority attention placed on returning that pulverizer back to service.

Baghouse Fly Ash Handling- during this test series (day shift) , we need to have both east and west fly ash handling systems available for full service.

All other normally operating equipment- needs to be in-service and operating. During this test series, we cannot test with a load derate which would effect Unit capability of 950 MWg. If this is not possible (or is unavoidable) , we need to know so that we can re-schedule the testing series to a later date.

I&C Support Requirements-

O2 Probe calibrations and technical support- We need the 3 bad O2 probes replaced and the weekly PM completed (troubleshooting walkdown and calibration). If we have additional problems or concerns, we will need technical support.

Coal Feeder calibrations- all coal feeders have been scheduled for calibrations prior to the test series (during the pulverizer shutdowns for dynamic restrictor installation)

Computer Group Support Requirements-

PI computer availability- The PI and Foxboro 1A computer systems need to be up and running. Please do not schedule and conduct backups during this period.

Operational Test Setup- Boiler OFA & Platen Tests

Load (MWgross) 950
Controls- boiler to local (or manual),
Boiler Test Objective is for stable boiler/ throttle pressure and let MWs float.
(throttling control valves okay- this is not a turbine test at valves wide open)
Overfire Air System to manual

Throttle Press & Control Valve Position as needed for load
Main Steam Temp (F) 1005
Main Steam spray (kpph) <200
Hot Reheat Temp (F) 1005
Reheat Sprays (kpph) 0
Bias Dampers (%) may have to take PRH side to manual & set between 30- 45%, to control RH temps

Sootblowing- as required to achieve Main Stm, HRH and FEGT temps

No sootblowing (during each test period of 2 hrs), sootblowing is allowed between each test

NOTE: for 950 MWg operation, need to allow SH & RH areas to get dirtier, but blow waterwalls to achieve FEGT (furnace exit gas temp) and EGOT (economizer gas outlet temp)

FEGT target (F) 2200, controlled by waterwall sootblowing
EGOT target (F) 760

O2 levels (measured at boiler outlet with test equipment)

VARIES from 3.5%, 3.0%, & 2.5% at 2 hour increments

Note: there is a discrepancy between station instrumentation and local test analyzers (local reads are higher by 0.5% to 1.0% O2)

Over Fire Air System local control

1/3 & 2/3 port dampers, VARIES from
5% OFA (baseline), both closed or inlet dampers closed
10% (1/3 damper open- balanced flow all 4 corners, 2/3 damper closed)
12%(2/3 damper open- throttled & balanced, 1/3 damper closed)
14% (2/3 dampers open- balanced flow all 4 corners, 1/3 damper closed)

NOx level target (#/mbtu) < 0.38
CO (ppm) < 100
Primary Air Duct Press ("wc) 43

Pulverizer Configuration- 7 I/S, U1F o/s (Sec air damper – 10%)

Note- Remove all pulverizer biasing (unless absolutely necessary due to unmanageable coal dribble)

NOTE: U1 F pulverizer o/s for major overhaul

Need all normally running equipment in-service (7 Pulv, all FD, PA & ID fans, etc.). This ensures good uniform air and gas flow distribution.

No Boiler Blowdown during the testing period

Isolate Unit 1 CRH to aux steam supply and route all building heat (if in service) drains to Unit 2.

Coal Supply – No Westridge or Dugout coal, need straight SUFCO for best emission results
No Rocks, please

NOTES (recaps):

- 1) Fly Ash Samples- need to be taken during each test period (need support of 2 Operators for fly ash sample collection). Fly Ash Hoppers need to be pulled down prior to the test (night shift) and between each test point. ISG will be collecting the fly ash samples at each test points. All fly ash hopper rows need to be available (no maintenance work)
- 2) Coal Supply- coal quality needs to be consistent (all from the same mine source) preferably from SUFCO.
- 3) Coal Samples will also be taken at each test point at the coal feeder inlet (new test coal sample collection ports). Note: there may be a certain amount of coal spillage created while collecting these coal samples.
- 4) Bottom ash samples will also be collected during some of the tests.
- 5) Do not washdown boiler in the backpass areas, due to test equipment, analyzers and computers.
- 6) PI computer system – needs to be up and running, no downtime or backups
- 7) CEM system – PI interface needs to be working